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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/711,697	09/30/2004	Ronald G. Filippi	FIS920040188US1	5696

45094 7590 04/12/2007

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EXAMINER	
AU, BAC H	
ART UNIT	**PAPER NUMBER**
2822	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	04/12/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	10/711,697	FILIPPI ET AL.	
	Examiner	Art Unit	
	Bac H. Au	2822	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *31 January 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

1. The Declaration filed on January 31, 2007 under 37 CFR 1.131 is sufficient to overcome the Bu (U.S. Pat. 7094669) reference.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claims 1-3 and 7 are rejected under 35 U.S.C. 102(b) as being anticipated by Nitta (U.S. Pub. 2001/0054764).

Regarding claims 1-3 and 7, Nitta [Figs.6A-D] discloses a method of forming a gas dielectric structure for a semiconductor structure, the method comprising the steps of:

forming an opening [13] for semiconductor structure in a dielectric layer [12] on a substrate [11];

depositing a sacrificial layer [41] over the opening such that the sacrificial layer fails to substantially fill the opening;

performing a directional etch on the sacrificial layer to form a sacrificial layer sidewall [41] on the opening after depositing the sacrificial layer; wherein the directional etching removes the sacrificial layer only from substantially horizontal surfaces [Para.74];

depositing a conductive liner [14] over the opening after performing the directional etch;

depositing a metal [16] in the opening after depositing the conductive liner;

planarizing the metal and the conductive liner [Fig.6C] after depositing the metal;

removing the sacrificial layer sidewall after the metal and the conductive liner are planarized, forming a void [15a]; and

depositing a cap layer [17] over the void to form the gas dielectric structure;

wherein the opening includes at least one wiring line opening [13] and at least one via [13];

wherein the void extends along a side of the at least one via [13];

wherein the conductive liner includes at least one of the group consisting of: tantalum (Ta), tantalum nitride (TaN), titanium (Ti), titanium nitride (TiN), tungsten (W) and niobium (Nb) [Para.75].

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 4-5, 11-13, 15, 17, and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nitta (U.S. Pub. 2001/0054764) in view of Cooney (U.S. Pub. 2004/0018714).

Regarding claims 4-5, 11, 13, and 17, Nitta discloses most of the limitations of the claims as discussed above, wherein the wiring layer is formed by a damascene process, but fails to explicitly disclose

performing a dual damascene process; a via-first dual damascene process; to form an opening including at least one wiring opening and at least one via in a dielectric layer on a substrate;

wherein the forming step includes depositing a hard mask, patterning the hard mask and etching the hard mask.

However, Cooney [Figs.13-26] discloses

performing a dual damascene process; a via-first dual damascene process; to form an opening including at least one wiring opening and at least one via in a dielectric layer on a substrate;

wherein the forming step includes depositing a hard mask [106], patterning the hard mask and etching the hard mask.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the teachings of Cooney into the method of Nitta to include performing a dual damascene process; a via-first dual damascene process; to form an opening including at least one wiring opening and at least one via in a dielectric layer on a substrate; and wherein the forming step includes depositing a hard mask, patterning the hard mask and etching the hard mask. The ordinary artisan would have been motivated to modify Nitta in the manner set forth above for at least the purpose of having a mask layer which would provide additional process flexibility in the formation of openings in the dielectric layer. Using hard masks and performing dual and via-first damascene processes are well-known in the art and are general knowledge to the ordinary artisan.

Regarding claims 12, 15, and 19, Nitta discloses these limitations as discussed above in claims 3 and 7.

4. Claims 8, 11, 16, 17 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nitta (U.S. Pub. 2001/0054764) in view of Cowley (U.S. Pub. 2004/0058526).

Regarding claims 8, 11, 16, 17 and 20, Nitta discloses most of the limitations of the claims as discussed above, wherein the wiring layer is formed by a damascene process, but fails to explicitly disclose

performing a dual damascene process; a via-first dual damascene process; to form an opening including at least one wiring opening and at least one via in a dielectric layer on a substrate; and

wherein the sacrificial layer includes one of the group consisting of: aluminum (Al), silicon dioxide (SiO_2) and titanium (Ti).

However, Cowley [Figs.2-9] discloses the method including

performing a dual damascene process; a via-first dual damascene process; to form an opening including at least one wiring opening and at least one via in a dielectric layer on a substrate; and

wherein the sacrificial layer [34] includes one of the group consisting of: aluminum (Al), silicon dioxide (SiO_2) and titanium (Ti) [Para.27 lines 1-7].

It would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the teachings of Cowley into the method of Nitta to include

performing a dual damascene process; a via-first dual damascene process; to form an opening including at least one wiring opening and at least one via in a dielectric layer on a substrate; and

wherein the sacrificial layer includes one of the group consisting of: aluminum (Al), silicon dioxide (SiO_2) and titanium (Ti).

The ordinary artisan would have been motivated to modify Nitta in the manner set forth above for at least the purpose of having a sacrificial layer that also functions as

a gettering layer to remove undesirable compounds from the interlevel dielectric [Cowley; para.27 lines 12-16].

5. Claims 6, 11, 14, 17 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nitta (U.S. Pub. 2001/0054764) in view of Tsai (U.S. Pub. 2003/0077897).

Regarding claims 6, 11, 14, 17 and 18, Nitta discloses most of the limitations of the claims as discussed above, wherein the wiring layer is formed by a damascene process, but fails to explicitly disclose

performing a dual damascene process; a via-first dual damascene process; to form an opening including at least one wiring opening and at least one via in a dielectric layer on a substrate; and

further comprising the step of depositing a non-conductive liner prior to the step of depositing the sacrificial layer, wherein the non-conductive liner includes one of the group consisting of: silicon nitride (Si_3N_4) and silicon dioxide (SiO_2).

However, Tsai [Figs.1a-f, 2c] discloses the method comprising the step of performing a dual damascene process; a via-first dual damascene process; to form an opening including at least one wiring opening and at least one via in a dielectric layer on a substrate; and depositing a non-conductive liner [250] prior to the step of depositing the sacrificial layer, wherein the non-conductive liner includes one of the group consisting of: silicon nitride (Si_3N_4) and silicon dioxide (SiO_2).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the teachings of Tsai into the method of Nitta to include in the method further comprising the step of depositing a non-conductive liner prior to the step of depositing the sacrificial layer, wherein the non-conductive liner includes one of the group consisting of: silicon nitride (Si_3N_4) and silicon dioxide (SiO_2). The ordinary artisan would have been motivated to modify Nitta in the manner set forth above for at least the purpose of forming a protective layer to prevent via poisoning in subsequent processing steps [Tsai; para.17].

6. Claims 9-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nitta (U.S. Pub. 2001/0054764) in view of Te Velde (U.S. Pat. 4561173).

Regarding claims 9-10, Nitta discloses the step of removing the sacrificial sidewall layer by etching, but fails to disclose in the method wherein the removing step includes etching the sacrificial sidewall layer using one of: a) water (H_2O) and sodium hydroxide (NaOH); b) water (H_2O) and hydrofluoric acid (HF); and c) hydrofluoric acid (HF) and hydrochloric acid (HCl); and wherein in the case that water (H_2O) and sodium hydroxide (NaOH) are used as an etchant, the ratio of H_2O to NaOH is no greater than approximately 10:1 and no less than 1:1.

However, Te Velde [Col.6 lines 51-55] discloses the method wherein the removing step includes etching the sacrificial sidewall layer using one of: a) water (H_2O) and sodium hydroxide (NaOH); b) water (H_2O) and hydrofluoric acid (HF); and c) hydrofluoric acid (HF) and hydrochloric acid (HCl); and wherein in the case that water

(H_2O) and sodium hydroxide (NaOH) are used as an etchant, the ratio of H_2O to NaOH is no greater than approximately 10:1 and no less than 1:1.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the teachings of Te Velde into the method of Nitta to include in the method wherein the removing step includes etching the sacrificial sidewall layer using one of: a) water (H_2O) and sodium hydroxide (NaOH); b) water (H_2O) and hydrofluoric acid (HF); and c) hydrofluoric acid (HF) and hydrochloric acid (HCl); and wherein in the case that water (H_2O) and sodium hydroxide (NaOH) are used as an etchant, the ratio of H_2O to NaOH is no greater than approximately 10:1 and no less than 1:1. The ordinary artisan would have been motivated to modify Nitta in the manner set forth above for at least the purpose of having an effective etchant with the desired selectivity.

Response to Arguments

7. Applicant's arguments with respect to the claims have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

8. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Bac H. Au whose telephone number is 571-272-8795. The examiner can normally be reached on Mon-Fri 8-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Zandra Smith can be reached on 571-272-2429. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

BHA

Zandra V. Smith
Supervisory Patent Examiner
9 April 2007